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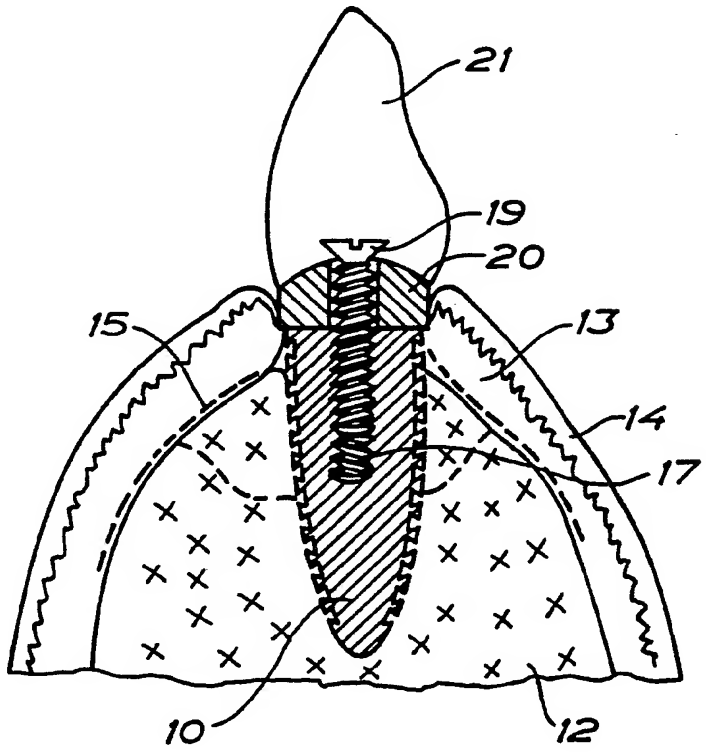

(57) Abstract

An implant for implantation into tooth alveoli, which comprises a root analogue (10) the external shape of which is substantially adapted to the shape of the root to be replaced by the root analogue in order that the root analogue when implanted in the tooth alveolus will be in agreement with the bone walls thereof.

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INTRAALVEOLAR IMPLANT

The present invention relates to an implant for implantation into tooth alveoli. It is previously well known that elements can be implanted by operation e.g. into jawbones so as to serve as permanent supports for artificial tooth crowns, tooth bridges, and tooth prostheses. In that case, prefabricated, often cylindrical implants commonly are used, which can be provided with one or more surface layers most often of a sintered material, comprising small spheres which together with the cavities defined by the spheres form undercuts for the growth of surrounding tissue thereinto and thus are considered to optimize the retention between the implant and the tissue. The cylindrical implants can also have threads, so-called screw implants, which can be implanted by means of surgical instruments and surgical technique which allow a very accurate and careful boring and threading of the bone tissue involved.

The implant materials vary from ceramics of different kinds to metals. The implant system which is far most satisfactorily proved in the literature and has the longest follow-up time, is based on the utilization of a screw type titanium implant, developed by Prof. Per Ingvar Brånemark and his collaborators in Gothenburg. This implant system demonstrates very good long-term results and is used by routine in clinical work.

All implants available on the market are characterized in that jawbone must be removed to make room for the implant. Then, extra-alveolar implants are concerned, i.e. implants which necessitate that the

jawbone outside the tooth alveoli are utilized completely or partly. Usually, the implantations then can be made in such regions only where there are no alveoli, i.e. in toothless regions with completely healed alveoli (the complete healing of alveoli usually taking at least 9 to 12 months).

Trials have been made to insert cylindrical implants into alveolar regions having fresh alveoli, i.e. alveoli that are not completely healed. However, this is problematical, because the healing will be unsatisfactory with a tendency of formation of soft tissue between the implant surface and the surrounding bone tissue if the cylinder is too narrow, and cutting-away of too much surrounding bone tissue if the implant cylinder has a large diameter. In other words, it is difficult to obtain sufficient congruence between the individual, often oval and slightly curved alveolus and the standardized implant cylinders. As a consequence thereof there cannot always be obtained the surface contact between bone and implant (so-called osseous integration) as seems to be a prerequisite for a good long-term prognosis of the implant.

The purpose of the present invention is to provide an implant which can be implanted without utilizing the extra-alveolar region outside the walls of the tooth alveolus involved. As a consequence thereof no surgical intervention has to be made in the bone tissue surrounding the alveolus.

For the purpose mentioned the implant of the invention has obtained the characterizing features according to claim 1. This avoids discrepancy between the implant surface and the surrounding bone tissue (alveolar walls) and makes possible to optimize osseous integration (healing of the bone against the implant surface without intervening soft tissue). Since the

implant is made as a very accurate tooth root analogue, it can very easily be inserted into the alveolus immediately after the extraction (removal) of the tooth or tooth root involved and an optimal, stable fixation can immediately be obtained, which is very essential in order to obtain the osseous integration mentioned above. This is further secured by the alveolus being accurately checked and if necessary being scraped to be cleaned from root membrane residues.

Alveoli which are some hours to 2 to 3 weeks old, can also be utilized as well as alveoli which are 1 to 3 months old. It is also possible to replace teeth which have been knocked out, by this type of implant which can be produced in one hour or two and, depending on the circumstances, thus can be implanted on the same day or on a predetermined day. If the tooth root is missing, a cast is made of the alveolus after the contents thereof having been shovelled or scraped therefrom, and a copy of the cast is made of a suitable implant material.

The invention will be explained in more detail below, reference being made to the accompanying drawings in which

FIG. 1 is a vertical sectional view of an implanted root analogue before this has been provided with a build-up,

FIG. 2 is a view similar to that of FIG. 1 after the implanted root analogue having been provided with an artificial tooth crown, and

FIG. 3 in a corresponding manner discloses another embodiment.

The implant indicated at 10 in the drawings, preferably consists of pure titanium, but it can also consist of a titanium alloy or another metal or ceramic, or it can be coated on the surface thereof with hydroxy apatite or another suitable material.

The implant can have undercuts 11 on the surface thereof for improved retention by growth of bone tissue 12 into the undercuts which, moreover, present an increased surface between the implant and the bone tissue. The undercuts can comprise knots, spheres (sintered metal) or cavities of other types or can comprise ribs which can be curved or can have acute, right, or obtuse angles. These surface variations preferably should be limited to include primarily the alveolar region but can extend somewhat above the bone alveolus so as to allow growth of the connective tissue 13 thereinto. This tissue is covered by epithelium 14 and together with the epithelium forms the soft tissue.

The unique shape of the implant (with the external contour accurately adapted to the wall of the alveolus involved) is obtained when the implant is made - e.g. of pure titanium - by a specific electroerosion technique. By using this technique the shape of the root analogue is varied in relation to the original root (or the alveolus) and is shaped e.g. in such a way that there is provided apically, in the lower portion of the root, such a volume that the root analogue presses slightly against the walls of the alveolus. By such adjusted overexpansion against the wall of the alveolus the primary fixation will be improved, which is essential for an undisturbed healing without growth of soft tissue 13, 14 inbetween the implant and the wall of the alveolus.

Furthermore, the implant can be provided in the cervical portion thereof (i.e. at the neck of the implant or root analogue) with a collar 15 which can consist of a titanium net or a titanium structure perforated in another manner, or of a net or perforated structure of another material, e.g. polytetrafluoro ethylene, which has been expanded and contains pores of

a suitable size. The collar can also consist of polyester or another suitable tissue-consistent material such as polyurethane. Moreover, the collar can consist of a resorptive material, possibly combined with a non-resorptive material of the kinds referred to. The resorptive material e.g. can consist of polydioxanon. The collar is shaped such that it connects to the neck of the root analogue completely sealing against the neck, and forms a baffle between the soft tissue layer (connective tissue 13 and epithelium 14) and the bone tissue 12. As a consequence thereof bone deficiencies 16 associated with the alveolus will be covered by the collar 15 which by separating the bone tissue 12 from the connective tissue 13 stimulates cells from the bone tissue to migrate into the bone deficiency 16 and to fill such deficiency with bone tissue (cfr. FIG. 2) and thus improve the fixation of the root analogue to the bone.

Preferably, the implanted root analogue is shaped such that it can be implanted with complete mucous membrane coverage, i.e. the mucous membrane is sutured over the root analogue located in the alveolus. The suture is indicated at 14'. The root analogue has, therefore, in connection with the electroerosion been cut at the highest bone level in the alveolus by means of e.g. laser technique which provides a junction having an extraordinarily good fit. Furthermore, the analogue forms a threaded central hole 17.

When the analogue is to be implanted, it is provided with a cover screw 18 which is screwed into the threaded hole. This cover screw can also function as an attachment for the collar 15 which is intended to contribute to guidance of the bone tissue growth into bone deficiencies possibly existing around the alveolus.

When the healing has taken place for 3 weeks to 3

months, stage 2 of the operation is effected, which means that the cover screw 18 is uncovered by incision, the cover screw being removed and being replaced by a fastening screw 19 which connects a cut-off apertured spacer 20 which in turn is exactly adapted to or alternatively forms the core of the tooth crown 21 involved. The tooth crown preferably is made of acrylate. When a collar 15 which is not resorptive, has been implanted together with the root analogue, this collar possibly can be removed in connection with stage 2 of the operation, but it can also be left where it is.

The cover screw 18 mounted on the root analogue in connection with the implantation thereof can consist of the cover screw already used in the implant system introduced by Brånemark. The end surface of the root analogue facing the cover screw, in this case is shaped as the end surface in said system, having a central threaded hole dimensioned as in this system. Then, components included in the Brånemark implant system, such as cover screw, spacer, spacer screw, and fastening screw, can be used for connecting the tooth crown involved to the tooth analogue.

In a specific embodiment, the root analogue can be connected also to a coupling element (Swedish patent applications Nos. 8504274-5 and 8504275-2) located between the analogue and the tooth crown.

In a further embodiment, FIG. 3, the central threaded hole 17 of the root analogue can be a through hole and extend over the total length of the root analogue such that the spacer screw 22 can be screwed through the entire root analogue and can be screwed into jawbone located apically of the root analogue, by self-threading or via the use of a thread tap. In this manner, the connection of the root analogue to surrounding jawbone (osseous integration) will be

improved by corresponding healing-in of the apical portion of the spacer screw extra-alveolarly apically of the alveolus.

CLAIMS

1. Implant for implantation into tooth alveoli, characterized in that the implant comprises a root analogue (10) the external shape of which is substantially adapted to the shape of the root to be replaced by the root analogue in order that the root analogue when implanted into the tooth alveolus will agree with the bone walls thereof.

2. Implant as in claim 1, characterized in that the external shape of the root analogue (10) is exactly adapted to the wall of the alveolus involved.

3. Implant as in claim 1 or 2, characterized in that the implant consists of titanium, titanium alloy, or another metal, or ceramic.

4. Implant as in claim 1 or 2, characterized in that the implant is coated on the surface thereof with hydroxy apatite or another suitable material.

5. Implant as in any of claims 1 to 4, characterized in that the implant on the outside surface thereof forms undercut cavities.

6. Implant as in any of claims 1 to 5, characterized in that the cervical portion of the implant is provided with a perforated or porous collar (15).

7. Implant as in any of claims 1 to 6, characterized in that the implant forms a central threaded hole (17).

8. Implant as in claim 7, characterized in that the hole is a through hole.

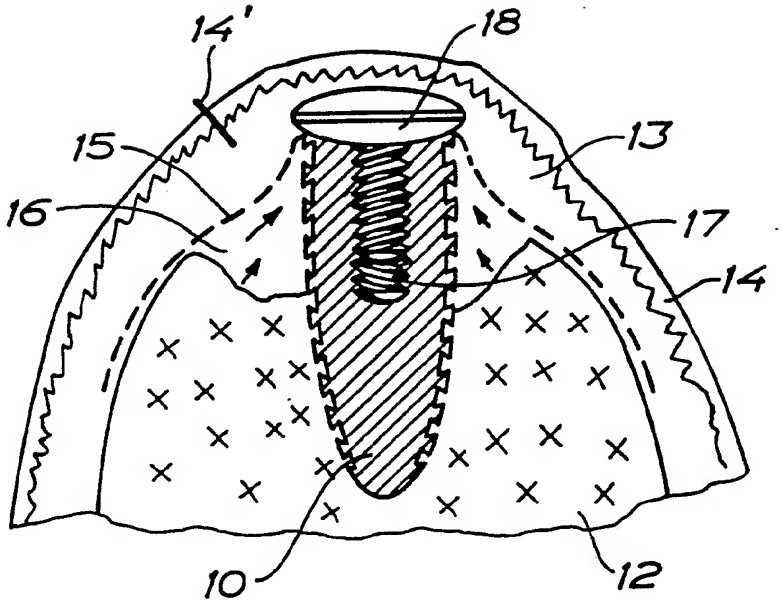

FIG. 1

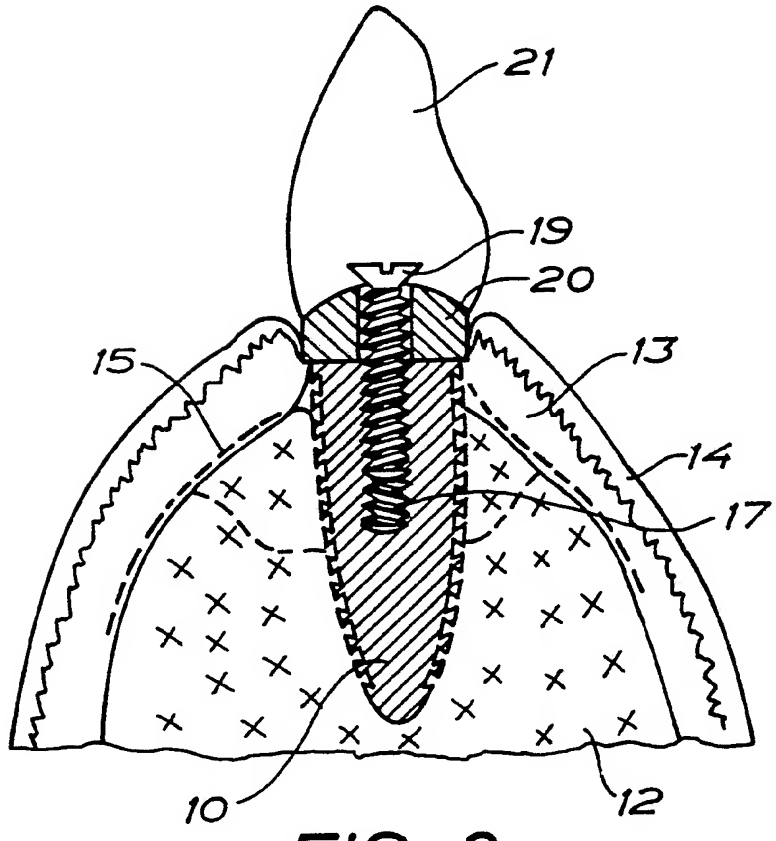

FIG. 2

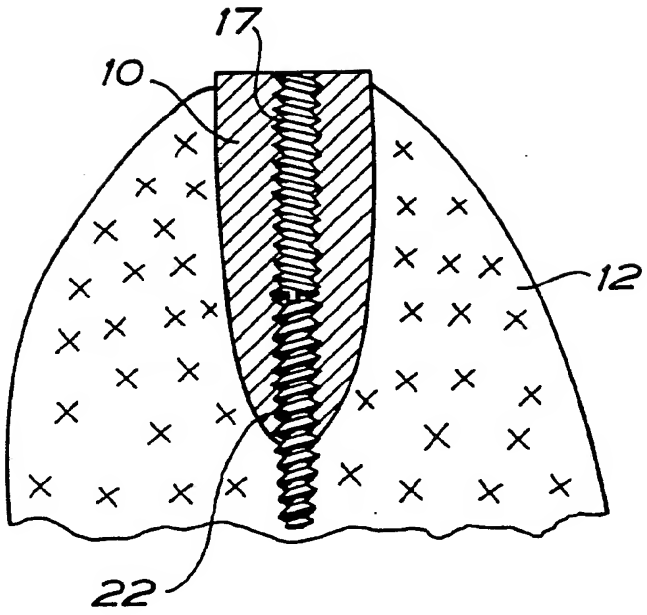

FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE87/00517

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

A 61 C 8/00 4

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC 4	A 61 C 8/00
US Cl	32: 10; 433: 172-176, 201

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	EP, A1, 0 053 903 (MEDICAL BIOLOGICAL SCIENCES, INC) 16 June 1982 & WO, 82/01989 US, 4536158 US, 4547327 CA, 1217366 AU, 561971	1-8
X	DE, A1, 2 729 969 (MICHIELI, SILVANO, VESCOVANA) 12 January 1978 & FR, 2357233	1-8
X	US, A, 3 576 074 (SIDNEY D. GAULT et al) 27 April 1971	1-8
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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
1988-01-26	1988 -01- 29
International Searching Authority	**Signature of Authorized Officer**
Swedish Patent Office	Jack Hedlund

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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
	& JP; 54024488 AU, 32965/78 GB, 1586646 CA, 1117797 SE, 7801533 SE, 429001 CH, 638092 AU, 511691	